Influence of fruit turgidity and firmness on apple bruise susceptibility

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Abstract

Bruise damage is a major cause of quality loss for apples. It would be very useful to establish a method of characterizing bruise susceptibility in order to improve fruit handling; sometimes Magness-Taylor firmness is used as an indirect guide to handling requirements. The objective of the present work was to achieve a better bruise susceptibility prediction.

"Delbare Estival" apples (n=132), picked in Belgium in two harvest dates, were tested along two weeks under different temperature (2°-18°C) and humidity (50-95% RH) conditions. These conditions were chosen to obtain a wide range of fruit turgidity and firmness.

The main variables measured were: weight loss (WL, %), Magness-Taylor firmness (MT, N), deformation at skin puncture (DSP, mm) and bruise volume (BV, mm^3). Tests applied to the fruits were the following:

- **Weight**.
- **Penetration test**. Performed using an UTS Machine with a standard Magness-Taylor 11.1-mm-diameter plunger at 20 mm/min, with the skin removed.
- **Skin puncture**. Performed using the same UTS Machine with a 0.5-mm-diameter puncture rod at 20 mm/min.
- **Impact test**. Impact tester used has been described previously (García et al., 1988). The test was conducted using a free falling mass (52.1 g) with 20-mm-diameter spherical head, dropped onto the fruit from a height of 8 cm.
- **Bruise size measurement**. Bruises were allowed to develop for over 2 h. Then, maximum width and depth of the bruise were measured cutting through the center of the bruised region. The volume of bruised tissue was calculated using the equation of Chen and Sun (1981).

Results showed that deformation at skin puncture was significantly correlated with weight loss (r=0.67); it has been shown previously (García et al., 1994) that deformation at skin puncture is a parameter closely related to fruit turgidity. Magness-Taylor firmness did not show a clear evolution along the testing period but showed significant differences for the harvest dates.

Bruise susceptibility showed a general decrease along the testing period. Bruise volume was related to weight loss (r=-0.47) and to the mechanical parameters Magness-Taylor firmness (r=-0.35 and deformation at skin puncture (r=-0.38). Firmer and less turgid fruit showed to be more resistant to bruising, as observed previously with different varieties of apples and pears (García et al., 1994).

Multiple linear regressions performed with these parameters for individual fruits were not able to predict accurately bruise volume variations (r^2=0.30). However, predictions could be done for averaged groups of six apples in the same conditions:

$$BV = 263.98 - 14.30\ WL - 1.62\ MT \qquad (n=132,\ r^2=0.72)$$

$$BV = 347.52 - 329.02\ DSP - 1.05\ MT \qquad (n=132,\ r^2=0.71)$$

The obtained models showed that the average bruise susceptibility of batches of six apples could be predicted from fruit weight loss and firmness data, or from the mechanical parameters deformation at skin puncture and firmness, with an error range lower than ±12% in both models.

Therefore, it is possible to evaluate the average bruise susceptibility of apple shipments from their mechanical parameters. Magness-Taylor firmness testing is a widely used procedure; skin puncture test could be easily developed, in order to determine fruit turgidity and, through the established models, bruise susceptibility. It would be also possible to consider other variables related to fruit turgidity to be used.

References

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